35. The liquid-crystal display of claim 9, wherein said particle beam in is directed at said dry deposited liquid-crystal alignment layer at an angle from about 10 to about 20 degree angle with the plane of the electrodes.

36. The liquid-crystal display of claim 30, wherein said particle beam in is directed at said dry deposited liquid-crystal alignment layer at an angle from about 10 to about 20 degree angle with the plane of the electrodes.

## REMARKS

Attached hereto is a marked-up version of the changes made to the specification and to the claims by the current amendments. The attached pages are captioned "**Version with Markings to Show Changes Made.**"

The Examiner has objected to the specification because the device described in Fig. 11a is not operable as a multi-domain LCD because the comb-like common electrodes 84 and the comb-like pixel electrodes 85 have the same electrical potential. The specification has been amended to describe reference numeral 82 as an in-plane switching mode liquid-crystal display comprising a TFT and bus line layer (detailed structure not shown but well known in the art). Accordingly, the common electrodes and the pixel electrode do not now have the same electrical potential.

Support for describing reference numeral 82 as an in-plane switching mode liquid-crystal display comprising a thin film transistor and bus line layer may be found on page 23, lines 25 to 31, which states that "[e]ach pixel electrode 112 is in communication on one end with the storage capacitor 110 and on the other end with thin film transistor 114. The thin film transistor 114 is in communication with data bus line 113 and gate bus line 115 and is selectively activated thereby, for turning the associated pixel on and off."

The Examiner has also objected to the specification as failing to provide an essential method of forming a combination of hydrogenated diamond-like carbon, amorphous hydrogenated silicon, silicon carbide, silicon dioxide, glass, silicon nitride, alumina, cerium oxide, tin oxide, and zinc titanate. Applicants respectfully point out that a claim is not made to an essential method of forming a combination of the compounds described. Support for claim 3, which has been amended to claim a dry deposit material selected from the group of compounds enumerated can be found in the specification on page 10, lines 4 to 13.

The Examiner has further objected to the specification as failing to provide an essential method of forming "dry deposited liquid crystal alignment layer" as claimed in claims 9 and 31. Applicants respectfully point out that support for claims 9 and 31 may be found in the specification page 10, lines 15 to 26, which states that "the alignment layer on the substrate is deposited by a dry deposition technique, using a suitable material, such as diamond-like carbon. Dry deposition of these materials is carried out by known methods, such as those described in the previously incorporated U.S. Patent No. 6,020,946. For example, a dry processed alignment layer is deposited onto a conductive transparent layer on a substrate, using a dry processing technique, such as plasma enhanced chemical vapor deposition (PECVD)."

In response herein, applicants have amended the independent claims 1, 9, 30 and 31 to further clarify their respective features. Applicants explain below that each of the independent claims is clearly distinguishable over the cited references.

The Examiner has rejected claim 21 under 35 U.S.C. § 112, second paragraph, as being indefinite. Claim 21 has been cancelled, accordingly, this rejection is moot.

Claims 1-3 under 35 U.S.C. § 103(a) are rejected as being obvious over U.S. Patent 6,061,111 to Samant et al. (hereinafter "Samant") in view of U.S. Patent 6,020,946 to Callegari et al. (hereinafter "Callegari").

Applicants respectfully point out that there is no teaching or suggestion anywhere in Samant for the method disclosed in the present invention for producing an in-plane, liquid crystal display using a dry deposited alignment layer and ion beam alignment, wherein the ion beam is placed in a direction so as to form an angle with the plane of the electrodes. The method of the present invention produces a substrate with a uniform ion structure, thereby producing a uniform field over the pixel and a wider viewing screen.

Applicants respectfully point out that Samant, in contrast, is directed to a method for producing a multi-domain liquid crystal display wherein an ion beam is directed at the surface of the alignment film at normal or vertical incidence. That is, the direction of the ion beam is perpendicular to the alignment film surface. Samant teaches alignment film bombardment in the presence of an electronic field passed through wires of a conducting material or a mask sufficient to redirect the ions of the particle beam from their initial, normal trajectory. This method produces a non-uniform ion field, as shown in Fig. 1, wherein the ion field density is dependent upon the random trajectory of the ions. In contrast, the present invention, using a dry alignment layer and ion beam alignment introduced at an angle negates the need for an electric field, wires or other conducting materials. Thus, the method in which the ion beam is applied to the substrate in Samant is fundamentally different from the method of the present invention. Moreover, the non-uniform ion field of Samant is fundamentally different from the uniform field of the present invention.

The Action relies on Callegari for teaching a method of preparing an alignment layer wherein the alignment layer is formed on the transparent conductive electrode, which is formed on the substrate, for driving liquid crystal molecules. Callegari does not, however, disclose a method for producing a multi-domain, liquid crystal display or an in-plane switching device. In contrast, Callegari is directed to a method for

producing a single domain liquid-crystal display. Thus, the combination of Samant and Callegari does not teach or suggest all the limitations of the instant claims.

To establish a proper *prima facie* case of obviousness, it is required that the reference (or combination of references) teach or suggest all the limitations of the claims in question. Since the combination of Samant and Callegari does not teach or suggest all the limitations of the instant claims, it does not render the instant claims obvious. Thus, claim 1, and claims 2 and 3, which depend directly or indirectly therefrom, are not obvious over Samant and Callegari. Therefore, the rejections of claims 1-3 under 35 U.S.C. § 103(a) should be withdrawn and claims 1 to 3 should be allowed.

Claims 1 and 4 to 7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,124,914 to Chaudhari et al. (hereinafter "Chaudhari") in view of Samant.

Applicants respectfully submit that the Chaudhari patent neither describes nor suggests all of the elements of the present invention. Chaudhari discloses a method of using a polyamide as an alignment film layer to form a single domain liquid crystal display device. In contrast, the present invention employs dry deposited non-polyamide materials as an alignment layer.

As discussed above, there is no teaching or suggestion anywhere in Samant for the method disclosed in the present invention for producing an in-plane, liquid crystal display using a dry deposited alignment layer and ion beam alignment, wherein the ion beam is placed in a direction so as to form an angle with the plane of the electrodes. Thus, the combination of Chaudhari and Samant does not teach or suggest all the limitations of the instant claims.

As mentioned above, to establish a proper *prima facie* case of obviousness, it is required that the combination of references teaches or suggests all the limitations of the claim in question. Since the combination of Chaudhari and Samant does not teach or suggest all the limitations of claim 1, it does not render claim 1 obvious. Accordingly, the rejections of claim 1 and claims 4 to 7, which depend directly or indirectly therefrom under 35 U.S.C. § 103(a) should be withdrawn and 1 and claims 4 to 7 should be allowed.

Claims 1, 8, 9 to 16 and 26 to 29 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,256,080 to Colgan et al (hereinafter "Colgan") in view of Samant.

Applicants respectfully submit that the Colgan patent neither describes nor suggests all of the elements of the present invention. Colgan is directed to a method of producing a liquid-crystal display having vertical alignment, wherein the alignment layer is a polyamide. Colgan does not teach a method of producing an in-plane, liquid crystal display using (1) a dry deposited alignment layer, (2) ion beam alignment, or (3) application of the ion beam in a direction so as to form an angle with the plane of the electrodes, as is claimed in claims 1 and 9 of the present application.

As discussed above, Samant fails to teach a method for producing an in-plane, liquid crystal display using a dry deposited alignment layer and ion beam alignment, wherein the ion beam is placed in a direction so as to form an angle with the plane of the electrodes.

As such, even if the teachings of the Colgan and Samant patents were somehow combined, as attempted by the Examiner, the resulting combination would still be deficient in teaching or suggesting the claimed subject matter.

In summary, Applicants respectfully submit that independent claims 1 and 9 are patentably distinguishable over the Colgan patent and the Samant patent, either alone or in combination. Claim 8 depends from claim 1, so it is also patentably distinguishable for at least the same reason as claim 1. Claims 10 to 16 and 26 to 29 depend from claim and 9, so they are also patentably distinguishable for at least the same reason as claim 9. Applicants respectfully request reconsideration and withdrawal of the section 103 rejection of claims 1, 8, 9 to 16 and 26 to 29.

Claims 17 to 25 and 30 were also rejected under 35 U.S.C. 103(a) as being unpatentable over Colgan in view of Samant.

As discussed above, Applicants respectfully submit that the Colgan patent neither describes nor suggests all of the elements of the present invention. Colgan is directed to a method of producing a liquid-crystal display having vertical alignment, wherein the alignment layer is a polyamide. Colgan does not teach a method of producing an in-plane, liquid crystal display using a dry deposited alignment layer and ion beam alignment. Moreover, there is no teaching or suggestion anywhere in Colgan for the method disclosed in the present invention for the application of ion beam alignment, wherein the ion beam is placed in a direction so as to form an angle with the plane of the electrodes, as is claimed in claims 9 and 30 of the present application. Moreover, Samant fails to teach a method for producing an in-plane, liquid crystal display using a dry deposited alignment layer and ion beam alignment, wherein the ion beam is placed in a direction so as to form an angle with the plane of the electrodes, as also claimed in claims 9 and 30.

As such, even if the teachings of the Colgan and Samant patents were somehow combined, as attempted by the Examiner, the resulting combination would still be deficient in teaching or suggesting the claimed subject matter.

In summary, Applicants respectfully submit that independent claims 9 and 30 are patentably distinguishable over the Colgan patent and the Samant patent, either alone or in combination. Claims 17 to 25 depend from claim 9, so they are also patentably distinguishable for at least the same reason as claim 9. Applicants respectfully request reconsideration and withdrawal of the section 103 rejection of claims 17 to 25 and claim 30.

Claims 31 and 33 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,949,509 to Ohe et al (hereinafter "Ohe").

Applicants respectfully submit that the Ohe patent neither describes nor suggests all of the elements of the present invention. Ohe is directed to a method of producing a liquid-crystal display having planar alignment, wherein the alignment layer is a polyamide. Ohe also teaches a contact alignment method, such as rubbing. Ohe does not teach a method of producing an in-plane, liquid crystal display using a dry deposited alignment layer and an ion beam alignment, as is claimed in claim 31. As such, Ohe is deficient in teaching or suggesting the claimed subject matter.

Applicants respectfully submit that independent claim 31 is patentably distinguishable over the Ohe patent. Claim 33 depends from claim 31, so it is also patentably distinguishable for at least the same reason as claim 31. Applicants respectfully request reconsideration and withdrawal of the section 103 rejection of claims 31 and 33.

Claim 32 was rejected under 35 U.S.C. 103(a) as being unpatentable over Ohe, as applied to claim 31 in view of Chaudhari.

As discussed above, Applicants respectfully submit that the Ohe patent neither describes nor suggests all of the elements of the present invention. Ohe is directed to a method of producing a liquid-crystal display having planar alignment, wherein the alignment layer is a polyamide and employing a contact alignment method, such as

rubbing. Ohe does not teach a method of producing an in-plane, liquid crystal display using a dry deposited alignment layer and ion beam alignment, as is claimed in claim 31.

Chaudhari discloses a method of using a polyamide as an alignment film layer to form a single domain liquid-crystal display device. Claim 31 of the present invention is directed to multi-domain alignment layer liquid-crystal display device. As such, even if the teachings of the Ohe and Chaudhari patents were somehow combined, as attempted by the Examiner, the resulting combination would still be deficient in teaching or suggesting the claimed subject matter.

In summary, Applicants respectfully submit that independent claim 31 is patentably distinguishable over the Ohe patent and the Chaudhari patent, either alone or in combination. Dependent claim 32, dependant on claim 31 is patentably distinct over the Ohe and Chaudhari combination for at least the same reasons as claim 31. Applicants respectfully request reconsideration and withdrawal of the section 103 rejection of claim 32.

Based on the above, applicants respectfully request reconsideration of the present application, withdrawal of the objections, the 35 U.S.C.112, second paragraph rejection, the 35 U.S.C. § 103(a) rejections, and allowance of claims 1 to 33. Accordingly, an early indication of the allowability of all pending claims by issuance of a Notice of Allowability is earnestly solicited.

Respectfully submitted,

Date: 7-8-02 By: Paul D Greeley

Paul D. Greeley
Reg. No. 31,019
Attorney for Applicants
Ohlandt, Greeley, Ruggiero
& Perle, L.L.P.
One Landmark Square, 10th Floor
Stamford CT 06901-2682
Tel: 203-327-4500
Fax: 203-327-6401

**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**IN THE SPECIFICATION:**

Page 22, line 29 to page 23, line 12.

The in-plane switching mode liquid-crystal display comprises bottom polarizer 80, bottom substrate 81, thin film transistor and bus line layer (detailed structure not shown but well known in the art) 82, a top polarizer 90, a top substrate 91, a color filter layer 92, a second transparent conductive layer 93, a plurality of common electrodes 84 disposed in the bottom substrate plane and a plurality of pixel electrodes 85 disposed in a staggering relationship therewith to form a comb-like structure, a first dry deposited liquid-crystal alignment layer 83, a second dry deposited liquid-crystal alignment layer 94 being spaced adjacent to and facing the first dry deposited liquid-crystal alignment layer 83, a plurality of uniformly sized transparent or non-transparent spacers 96 distributed within the space, a liquid-crystal material 95 disposed in the space between the alignment layers. The spacers can be pearl or post shaped.

**IN THE CLAIMS:**

The claims have been amended as follows:

1. (Amended) A method of preparing a multi-domain, dry deposited liquid-crystal alignment layer, ~~wherein said~~ by at least one method ~~is~~ selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field;

wherein said dry deposited liquid-crystal alignment layer is exposed to a particle beam; and

wherein said particle beam is directed at said dry deposited liquid-crystal alignment layer at an adjustable angle with respect to said dry deposited liquid-crystal alignment layer.

3. (Amended) The method of claim 2, wherein said dry deposit layer material is selected from the group consisting of: hydrogenated diamond-like carbon, amorphous hydrogenated silicon, silicon carbide (SiC), silicon dioxide ($SiO_2$), glass, silicon nitride ($Si_3N_4$), alumina ($Al_2O_3$), cerium(IV) oxide ($CeO_2$), tin oxide ($SnO_2$), zinc titanate ($ZnTiO_2$) and a combination thereof.

9. (Amended) A multi-domain, wide viewing angle liquid-crystal display, comprising:

a bottom substrate having a first surface;

a first transparent conductive layer disposed over said first surface of said bottom substrate;

a top substrate having a second surface;

a color filter layer disposed over said second surface of said top substrate;

a second transparent conductive layer disposed over said color filter;

a first dry deposited liquid-crystal alignment layer over said first transparent conductive layer;

a second dry deposited liquid-crystal alignment layer over said second transparent conductive layer; said second dry deposited liquid-crystal alignment layer being spaced adjacent to and facing said first dry deposited liquid-crystal alignment layer;

a plurality of uniformly sized transparent or non-transparent spacers distributed within said space; and

a liquid-crystal material disposed in the space therebetween;

wherein each of said first alignment layer and said second alignment layer is divided into a plurality of pixels each having a boundary and at least two domains; ~~and~~ wherein each of said multi-domain, dry deposited liquid-crystal alignment layers is

obtained by a method selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field methods~~.~~

wherein said dry deposited liquid-crystal alignment layer is exposed to a particle beam; and

wherein said particle beam is directed at said dry deposited liquid-crystal alignment layer at an adjustable angle with respect to said dry deposited liquid-crystal alignment layer.

30. (Amended) An improved method of preparing an in-plane switching mode liquid-crystal display of the type having the steps of forming a first polyamide alignment layer and a second polyamide alignment layer, wherein each of the first and second layers is rubbed with a mechanical roll wrapped in a velvet cloth, wherein the improvement comprises the steps of:

forming a first dry deposited alignment layer;

forming a second dry deposited alignment layer;

spacing said first dry deposited alignment layer and said second dry deposited alignment layer adjacent to and facing each other; and

filling a liquid-crystal material in the space therebetween;

wherein each of said dry deposited liquid-crystal alignment layers is obtained by a method selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field~~.~~;

wherein said dry deposited liquid-crystal alignment layer is exposed to a particle beam; and

wherein said particle beam is directed at said dry deposited liquid-crystal alignment layer at an adjustable angle with respect to said dry deposited liquid-crystal alignment layer.

31. (Amended) A wide viewing angle in-plane switching mode liquid-crystal display, comprising:

a bottom polarizer;

a bottom substrate;

a top polarizer;

a top substrate;

a color filter layer disposed over a surface of said top substrate;

a plurality of common electrodes disposed in the bottom substrate plane and a plurality of pixel electrodes disposed in a staggering relationship therewith to form a comb-like structure for producing an electric field parallel to plane of said bottom substrate so that when operated, the molecules of said liquid-crystal material are switched to rotate by said vertical electric field in a direction parallel to the substrate surface;

a first dry deposited liquid-crystal alignment layer over said bottom substrate and said comb-like electrodes;

a second dry deposited liquid-crystal alignment layer over said color filter layer; said second dry deposited liquid-crystal alignment layer being spaced adjacent to and facing said first dry deposited liquid-crystal alignment layer;

a plurality of uniformly sized transparent or non-transparent spacers distributed within said space; and

a liquid-crystal material disposed in the space therebetween~~;~~.

wherein said dry deposited liquid-crystal alignment layer is exposed to a particle beam; and

wherein said particle beam is directed at said dry deposited liquid-crystal alignment layer at an adjustable angle with respect to said dry deposited liquid-crystal alignment layer.